

## CONSTRUCTION SPECIFICATION

### VA-732. REINFORCED CONCRETE CONSTRUCTION

#### 1. SCOPE

This specification covers steel reinforced concrete construction. Construction work covered by this specification shall not be performed unless the anticipated atmospheric daily low temperature is 40°F (4°C) or higher for a minimum of three days after placement unless the site conditions and/or the construction methods to be used have been reviewed and approved in writing by the NRCS Engineer or their designated representative.

#### 2. PREPARATION OF FORMS AND SUBGRADE

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. The temperature of all surfaces to be in contact with the new concrete shall be not be less than 40 degrees Fahrenheit. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed. Rock surfaces shall be cleaned by air-water cutting, wet sandblasting, or wire brush scrubbing, as necessary, and shall be wetted immediately before placement of concrete. Surfaces against which concrete is to be placed shall be firm and damp. Placement of concrete on mud, dried earth, or uncompacted fill or frozen subgrade is not permitted.

Unless otherwise specified, when concrete is to be placed over drain fill, the contact surface of the drain fill shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete. Forms for weepholes shall extend through this layer into the drain fill.

Weepholes in walls or slabs shall be formed with nonferrous material.

Unless otherwise indicated on the construction drawings, concrete shall be placed on a smoothly graded soil or sand subgrade compacted, as necessary, to a uniform density throughout. Over-excavation shall be corrected by a procedure approved by the NRCS representative.

#### 3. FORMS

Forms shall be of wood, plywood, steel, or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities. Form release agents appropriate for the form materials and concrete admixtures shall be used.

Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete. Ties designed to break off below the surface of the concrete shall not be used without cones.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Tolerance on formed concrete is  $\pm 3/8$  inch. Tolerance on concrete formed in earth is -1 inch to +6 inches.

#### 4. CONCRETE MIX

When ready-mixed concrete is furnished, the Contractor shall furnish the NRCS representative a statement-of-delivery ticket showing the time of loading, the revolution counter reading at the time of loading and the quantities of materials used for each load of concrete. The quantities of materials shall include mixing water and estimated free water in the aggregates.

Portland cement shall be Type I or IA. If Type IA cement is used, additional air entrainment admixture shall be the same type used in the cement. Cement that is partially hydrated (hardened), or otherwise damaged, shall not be used. Pozzolan (fly ash) meeting the requirements of ASTM C 618, Class F or C, may be used. Cement may be replaced with fly ash in quantities of up to 20% by weight of the total required cement.

Air entrainment, if specified, shall be 4 to 7 percent of the volume of the concrete.

Aggregates shall consist of clean, hard, strong and durable particles that are free of silt, clay or any other material that may affect bonding of the cement paste. Fine and coarse aggregates shall meet the requirements of ASTM C 33.

Water shall be clean and free of injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances. Aggregate moisture shall be included in water quantity calculations. The water-cement ratio shall be 0.49 or less.

Water reducing admixtures conforming to ASTM C 494, Types A, D, F, or G may be used. Types D or G may be used at the discretion of the contractor/supplier when the air temperature is over 80° F (27° C).

Concrete for structures shall have a minimum 28-day compressive strength of 3,500 psi or be as shown on the drawings. In lieu of strength tests, a mix containing the following per cubic yard may be accepted:

| Mix Number | Min. Cement<br>lb./bags | Fly Ash<br>lb. | Max. Water<br>(lb./gal.) |
|------------|-------------------------|----------------|--------------------------|
| 1          | 564/6                   | 0              | (275/33)                 |
| 2          | 470/5                   | 54             | (259/31)                 |

The slump of the concrete shall be 3 to 5 inches. Maximum slump of concrete prior to adding high range water reducers shall be 2 1/2". Maximum slump after adding high range water reducers shall be 6 1/2".

#### 5. MIXING AND PLACING CONCRETE

Concrete shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved by the NRCS representative. The representative shall be notified far enough in advance to provide time for the inspection.

Concrete shall be uniform and thoroughly mixed when delivered to the job sites.

Concrete shall be discharged into the forms, vibrated and spaded within 90 minutes after the cement has been introduced into the aggregates. When air temperatures are above 85°F (29°C), this time must be reduced to 45 minutes. The NRCS representative may allow a longer time if an approved set retarding admixture is used.

Concrete shall be deposited as close as possible to its final position. It shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. Concrete without Type F or G water reducers shall not be allowed to drop more than 5 feet from a chute or "elephant trunk". Concrete with Type F or G water reducers shall not be allowed to drop more than 10 feet from the chute or "elephant trunk". Concrete shall not be allowed to flow laterally more than 8 feet.

If concrete must be dropped more than allowed above, hoppers and chutes, "elephant trunks", etc., shall be used to prevent segregation.

If concrete must be moved laterally more than 8 feet, it shall be moved by shoveling, chutes, conveyors, wheelbarrows or similar equipment.

Immediately after placement, concrete shall be consolidated by spading and vibrating, or spading and hand tamping. It shall be worked into corners and angles of the forms and around all reinforcement and embedded items in a manner which prevents segregation or the formation of "honeycomb". Excessive vibration which results in segregation of materials will not be allowed. Vibration shall not be used to make concrete flow in the forms.

Concrete in slabs shall be placed at design thickness in one layer, but walls should be placed in essentially horizontal layers not more than 24 inches high. Successive layers shall be placed and consolidated fast enough to ensure a good bond between layers and to prevent "cold joints".

If the surface of a layer in place will develop its initial set before more concrete is placed on it, a construction joint (of the type shown in the plan) shall be made.

Concrete surfaces shall be smooth and even. Careful screeding (striking-off) and/or wood or magnesium float finishing are required. If an impervious, protective coating will be applied to the surface of the concrete, follow the coating manufacturer's recommendations for surface preparation.

The addition of dry cement or water to the surface of screeded concrete to expedite finishing will not be allowed.

If placing is discontinued when an incomplete horizontal layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead.

## 6. REINFORCING STEEL

Reinforcing steel shall be deformed bars manufactured specifically for concrete reinforcement and shall be a minimum of Grade 60 or as shown on the drawings (additional details can be found in ASTM-A-615, A-616 or A-617).

Reinforcing steel shall be free from loose rust, concrete, oil, grease, paint or other deleterious coatings.

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. This shall be accomplished by tying reinforcing steel or special tie bars to the form "snap ties" or by other methods of tying. No welding of either stress steel or temperature and shrinkage steel will be permitted. Reinforcing steel shall not be heated to facilitate bending.

In slabs, steel shall be supported by precast concrete bricks (not clay bricks), corrosion resistant metal chairs or plastic chairs.

The following tolerances will be allowed in the placement of reinforcing bars.

- a. Where 1.5 inches clear distance is shown between reinforcing bars and forms, allowable clear distance is 1-1/8 to 1-1/2 inches.
- b. Where 2 inches clear distance is shown between reinforcing bars and forms, allowable clear distance is 1-5/8 to 2 inches.
- c. Where 3 inches clear distance is shown between reinforcing bars and earth or forms, allowable clear distance is 2-1/2 to 3 inches. Overexcavation backfilled with concrete shall not count toward clear distance.
- d. Maximum variation from indicated reinforcing bar spacing: 1/12th of indicated spacing, but no reduction in amount of bars specified.

Unless otherwise indicated on the drawings, splices of reinforcing bars shall provide a lap of not less than 30 diameters of the smaller bar but not less than 12 inches. Bars will not be spliced by welding. Welded wire fabric shall be lapped at least one mesh width.

The ends of all reinforcing bars shall be covered with at least 1.5 inches of concrete.

#### 7. CONSTRUCTION JOINTS

Construction joints shall be made at the locations shown on the drawings. If construction joints are needed that are not shown on the drawings, they shall be placed in locations approved by the engineer.

Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than 6 inches.

In walls and columns, as each lift is completed, the top surface shall be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened. New concrete shall not be placed until the hardened concrete has cured at least 12 hours.

Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the engineer. The surface shall be kept moist for at least 1 hour before the new concrete is placed.

#### 8. EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints shall be made only at locations shown on the drawings. Expansion joints shall be constructed of bituminous fiber-type material such as that specified by ASTM D-994. Expansion joint material shall be 1/2 inch thick unless otherwise specified.

Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

When open joints are specified, they shall be constructed by the insertion and subsequent removal of a wooden strip, metal plate, or other suitable template in such a manner that the corners of the concrete are not chipped or broken. The edges of open joints shall be finished with an edging tool before the joint strips are removed.

9. WATERSTOPS

Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal waterstops shall be soldered, brazed, or welded. Joints in rubber or plastic waterstops shall be cemented, welded, or vulcanized as recommended by the manufacturer.

10. CURING

Concrete shall be prevented from drying for at least seven days after it is placed. Exposed surfaces shall be kept continuously moist during this period by covering with moistened canvas, burlap, straw, sand or other approved material, unless they are sprayed with a curing compound or covered with a 4 mil or thicker polyethylene. Forms left in place during the curing period shall be kept wet.

If an impervious, protective coating will be applied to the surface of the concrete, follow the coating manufacturer's recommendation for concrete curing beyond the seven days required above. Other concrete, except at construction joints, may be coated with a curing compound in lieu of continued application of moisture. The compound shall be sprayed on moist concrete surfaces as soon as free water has disappeared, but shall not be applied to any surface until patching, repairs and finishing of that surface are completed.

Curing compound shall be applied in a uniform layer over all surfaces requiring protection at a rate of not less than 1 gallon per 150 square feet of surface or to manufacturer's recommendation, whichever is greater.

11. FORM REMOVAL AND CONCRETE REPAIR

Forms for structure walls shall not be removed until 24 hours or more after concrete placement. When forms are removed in less than seven days, the concrete shall be sprayed with a curing compound or be kept wet continuously by methods allowed in Section 10 of this specification.

Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that permits the concrete to take the stresses of its own weight uniformly and gradually. Forms shall be removed before walls are backfilled.

Form ties shall be removed flush with or below the concrete surface for structures which are not required to be liquid tight.

Form ties shall be removed to a minimum depth of 1/2 inch for structures which are to be liquid tight. In lieu of this requirement for waste storage tanks, an asphalt type sealer may be put on the entire wall surface.

All cavities resulting from form tie removal shall be patched with dry-pack mortar.

Where areas of the concrete surface is "honeycombed", damaged or otherwise defective, it shall be removed, the area wetted and then filled with a dry-pack mortar. Damaged or defective concrete shall be removed and/or repaired so as to retain structural integrity of the member. Dry-pack mortar shall consist of one part Portland cement and three parts sand, with just enough water to produce a workable consistency.

#### 12. CONCRETING IN COLD WEATHER

Concrete shall not be mixed nor placed when the daily atmospheric low temperature is less than 40°C (4°F) unless facilities are provided to prevent the concrete from freezing.

Facilities for cold weather concreting shall consist of:

- a. Use of warm concrete with temperatures from 55° to 65°F (13° to 18°C).
- b. Adequate protection from the weather, including the use of artificial heat, to prevent the temperature of the concrete from falling below 50°F (10°C) for a period of three days, and the relative humidity of the air near the concrete from falling below 40 percent.
- c. Accelerators such as calcium chloride may not be used to speed the hardening of concrete.
- d. The contractor shall furnish to NRCS for approval, a written plan that shows how the contractor will meet the requirements of this specification. The plan must also show how the requirements of ACI Specification 306: Standard Specification for Cold Weather Concreting will be met.

#### 13. CONCRETING IN HOT WEATHER

Hot weather precautions should be taken when air temperatures are at or above 85°F (29°C).

Concrete temperature shall be less than 90°F (32°C) during mixing, conveying and placing. The concrete shall be placed within 45 minutes after mixing if the temperature of the concrete is 85°F or above. Exposed surfaces shall be continuously moistened by means of fog sprays or otherwise protected from drying during the time between placement and finishing and after finishing. Finishing of slabs and exposed surfaces shall commence as soon as the condition of the concrete allows and be completed without delay.

#### 14. BACKFILLING NEW CONCRETE WALLS

Heavy equipment may not be operated within 3 feet of the new concrete wall. Compaction within 3 feet of the wall will be by means of hand tamping or small hand-held tamping or vibrating equipment.

Backfilling and compaction of fill adjacent to new concrete walls shall not begin in less than 10 days after placement of the concrete or until the concrete strength at the site has been tested to be at least 2600 psi. Backfill material shall be the type indicated on the drawings and shall be free of large stones or debris.